2(a) Suppose that the two dimensional continuous random variable \((X, Y)\) is uniformly distributed over the region \(R\) bounded by \(y = x\) and \(y = x^2\). Find the marginal pdf's of \(X\) and \(Y\).
2 (a') Suppose that the following table represents the joint probability distribution of the discrete random variable \((X, Y)\):

\[
\begin{array}{c|ccc}
Y & X & 1 & 2 & 3 \\
\hline
1 & & & & \\
& 1 & \frac{1}{12} & \frac{1}{6} & 0 \\
2 & & & & \\
& 0 & \frac{1}{9} & \frac{1}{5} & \\
3 & & & & \\
& 1 & \frac{1}{18} & \frac{1}{4} & \frac{2}{15} \\
\end{array}
\]

Compute the following

(i) Conditional distributions of \(Y\) for given \(X\)

(ii) \(E(X)\) and \(Var(X)\).

(iii) Are \(X\) and \(Y\) independent variables?

2(b) Let \(X\) represent the life length of an electronic device and suppose that \(X\) is a continuous random variable with pdf:

\[
f(x) = \begin{cases} 
\frac{1000}{x^2} & ; x \geq 1000 \\
0 & ; \text{elsewhere}
\end{cases}
\]

Let \(X_1\) and \(X_2\) be two independent determinations of the above random variable \(X\).

Find the pdf of the random variable \(Z = \frac{X_1}{X_2}\).

3(a) Assuming that the populations from which the following samples (Ultimate tensile strength (ksi) of alloy steel (Maraging H) at room temperature) :

251, 255, 258, 253, 253, 252, 250, 252, 255, 256

are taken normal, determine a 95% confidence interval for the variance \(\sigma^2\) of the population.
3 (b) In 1950 in India the mean life expectancy was 50 years. If the life expectancies from a random sample of 11 persons are 58.2, 56.6, 54.2, 50.4, 44.2, 61.9, 57.5, 53.4, 49.7, 55.4, 57.0, test the null hypothesis \( \mu = 50 \) against the alternative hypothesis \( \mu \neq 50 \) at 0.05 level of significance.

4(a) Prove that
\[
\frac{d}{dx} \left( J_n^2(x) + J_{n+1}^2(x) \right) = \frac{2}{x} \left\{ n J_n^2(x) - (n+1) J_{n+1}^2(x) \right\}.
\]

4(b) Prove that
\[
P_n(x) = \frac{1}{\pi} \int_0^\pi \frac{d\phi}{[x + \sqrt{x^2 - 1} \cos \phi]^{n+1}}
\]

OR

4(b') Show that
\[
T_n(x) = \sum_{m=0}^{\left[ \frac{n}{2} \right]} \frac{(-1)^m n! (1 - x^2)^m x^{n-2m}}{(2m)! (n-2m)!}.
\]
### Table A10: Chi-square Distribution

Values of $x$ for given values of the distribution function $F(z)$ (see p. 1115)

Example: For 3 degrees of freedom, $z = 11.34$ when $F(z) = 0.99$.

<table>
<thead>
<tr>
<th>Number of Degrees of Freedom</th>
<th>0.005</th>
<th>0.01</th>
<th>0.025</th>
<th>0.05</th>
<th>0.10</th>
<th>0.25</th>
<th>0.50</th>
<th>0.75</th>
<th>0.95</th>
</tr>
</thead>
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<td>0.005</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>0.95</td>
<td>3.84</td>
<td>5.99</td>
<td>7.81</td>
<td>9.49</td>
<td>11.07</td>
<td>12.59</td>
<td>14.07</td>
<td>15.51</td>
<td>16.92</td>
</tr>
<tr>
<td>0.975</td>
<td>5.02</td>
<td>7.38</td>
<td>9.35</td>
<td>11.14</td>
<td>12.83</td>
<td>14.45</td>
<td>16.01</td>
<td>17.53</td>
<td>19.02</td>
</tr>
<tr>
<td>0.99</td>
<td>6.63</td>
<td>9.21</td>
<td>11.34</td>
<td>13.28</td>
<td>15.09</td>
<td>16.81</td>
<td>18.48</td>
<td>20.09</td>
<td>21.67</td>
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<tr>
<td>0.995</td>
<td>7.88</td>
<td>10.60</td>
<td>12.84</td>
<td>14.86</td>
<td>16.75</td>
<td>18.55</td>
<td>20.28</td>
<td>21.96</td>
<td>23.59</td>
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</table>

### 4. $t_{a}$-Critical Values of the $t$-Distribution

<table>
<thead>
<tr>
<th>$v$</th>
<th>$0.40$</th>
<th>$0.30$</th>
<th>$0.20$</th>
<th>$0.15$</th>
<th>$0.10$</th>
<th>$0.05$</th>
<th>$0.025$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.325</td>
<td>0.727</td>
<td>1.376</td>
<td>1.963</td>
<td>3.078</td>
<td>6.314</td>
<td>12.706</td>
</tr>
<tr>
<td>2</td>
<td>0.289</td>
<td>0.617</td>
<td>1.061</td>
<td>1.386</td>
<td>1.886</td>
<td>2.920</td>
<td>4.303</td>
</tr>
<tr>
<td>3</td>
<td>0.277</td>
<td>0.584</td>
<td>0.978</td>
<td>1.250</td>
<td>1.638</td>
<td>2.353</td>
<td>3.182</td>
</tr>
<tr>
<td>4</td>
<td>0.271</td>
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<td>0.941</td>
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<td>1.533</td>
<td>2.132</td>
<td>2.776</td>
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<tr>
<td>5</td>
<td>0.267</td>
<td>0.559</td>
<td>0.920</td>
<td>1.156</td>
<td>1.476</td>
<td>2.015</td>
<td>2.571</td>
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<tr>
<td>6</td>
<td>0.265</td>
<td>0.553</td>
<td>0.906</td>
<td>1.134</td>
<td>1.440</td>
<td>1.943</td>
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<tr>
<td>7</td>
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<td>0.896</td>
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<td>1.397</td>
<td>1.860</td>
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<td>9</td>
<td>0.261</td>
<td>0.543</td>
<td>0.883</td>
<td>1.100</td>
<td>1.383</td>
<td>1.833</td>
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<tr>
<td>10</td>
<td>0.260</td>
<td>0.542</td>
<td>0.879</td>
<td>1.093</td>
<td>1.372</td>
<td>1.812</td>
<td>2.228</td>
</tr>
<tr>
<td>11</td>
<td>0.260</td>
<td>0.540</td>
<td>0.876</td>
<td>1.088</td>
<td>1.363</td>
<td>1.796</td>
<td>2.201</td>
</tr>
<tr>
<td>12</td>
<td>0.259</td>
<td>0.539</td>
<td>0.873</td>
<td>1.083</td>
<td>1.356</td>
<td>1.782</td>
<td>2.179</td>
</tr>
<tr>
<td>13</td>
<td>0.259</td>
<td>0.537</td>
<td>0.870</td>
<td>1.079</td>
<td>1.350</td>
<td>1.771</td>
<td>2.160</td>
</tr>
<tr>
<td>14</td>
<td>0.258</td>
<td>0.537</td>
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<td>1.076</td>
<td>1.345</td>
<td>1.761</td>
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<tr>
<td>15</td>
<td>0.258</td>
<td>0.536</td>
<td>0.866</td>
<td>1.074</td>
<td>1.341</td>
<td>1.753</td>
<td>2.131</td>
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</tbody>
</table>
2017-18
M.TECH. (AUTUMN SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
ELECTRONIC CIRCUITS
EL-611

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Assume suitable data if missing.
Notations and symbols used have their usual meaning.

Attempt ALL questions.

Q.No. Question M.M. CO

1 Figure 1 shows the internal circuit of the LM733 video amplifier.
   a) Identify and explain the operation of the biasing stage.
   b) What is the significance of $R_{11}$ and $R_{12}$?
   c) Derive an expression for the overall voltage gain.
   d) As can be seen, transistors $Q_1$–$Q_2$ constitute a differential pair and
      transistors $Q_3$–$Q_4$ form another differential pair. What is the need of
      having two differential amplifiers?

1’ (a) Explain the operation of the BJT-based Four-Quadrant Transconductance
      Multiplier shown in Figure 2. [8] CO-3

1’ (b) Show that the circuit shown in Figure 3 is a 4-Quadrant Analog Multiplier. [7] CO-3

2(a) Explain how the Cascode configuration can be used to extend the
     bandwidth of an amplifier. [08] CO-1

2(b) Design a Voltage Comparator circuit using OTAs and passive components
     only. [07] CO-1

3(a) Design a circuit to provide an output signal frequency equal to $n \cdot f_{ref}$
     where $f_{ref}$ is the input signal frequency, and $n = \{2, 4, 8\}$. Assume that
     the input signal is a square wave and the output waveform desired is also a
     square wave. [08] CO-4

3(b) Draw the block diagram of a PLL and explain its operation. If the
     sensitivity ($K_p$) of the VCO used in the PLL is 500 Hz/V, what is the
     change in the output frequency of the VCO for an input equal to 0.2 Volt? [07] CO-4

4(a) Design a Phase Frequency Detector using JK-Flip Flops. The circuit
     should be capable of comparing the trailing edges of the two digital input
     signals. [08] CO-1

Cond...2.
4(b) Design a Digitally Controlled Oscillator capable of generating 3 phase sinusoidal waveforms of frequency 100 KHz.

OR

4'(a) A voltage controlled oscillator is to be designed for some application. The required tunable range of frequencies is from 88 MHz to 108 MHz. Design a suitable OTA-based circuit.

4'(b) Design a circuit for Triangular-to-Sinusoidal waveform conversion.

Figure 1

Figure 2

Figure 3
2017-18  
M.TECH. (AUTUMN SEMESTER) EXAMINATION  
ELECTRONICS ENGINEERING  
ADVANCE DEVICE MODELLING  
EL-613

Maximum Marks: 60  
Credits: 04  
Duration: Two Hours

Answer all the questions.  
Assume suitable data if missing.  
Notations used have their usual meaning.

<table>
<thead>
<tr>
<th>Q. No.</th>
<th>Question</th>
<th>M. M.</th>
</tr>
</thead>
</table>
| 1(a)   | Plot the logarithm of the magnitude of the inversion layer charge, ln|Q_i||, vs the surface potential \( \psi_s \). Verify that it approaches straight-line both in "weak" and 'strong' inversion.  

\[ \text{(Based on CO "2")} \] | [5] |
| 1(b)   | What do you mean by 'Channel Length Modulation' used in short channel MOSFET devices? Briefly explain how it affects the output impedance.  

\[ \text{(Based on CO "1" & "2")} \] | [5] |
| 1(c)   | Show that for a 2-terminal MOS structure,  
\[ n = 1 + \frac{C_{ch} + C_{t}'}{C_{ox}} \]  
when trap charge \( Q_{t} \) is also included can be expressed as:  

\[ \text{(Based on CO "2")} \] | [5] |

(OR)

| 1'(a)  | Plot \(|Q_i|\) vs. \(V_{gs}\) between \(V_{la}\) and \(V_{in} + 5V\) for 3-terminal MOS-structure. Verify its nature by giving relevant theory.  

\[ \text{(Based on CO "2")} \] | [5] |
| 1'(b)  | What do you mean by 'DIBL Effect' used in short channel MOSFET devices? Briefly explain how it affects the threshold voltage.  

\[ \text{(Based on CO "1" & "2")} \] | [5] |
| 1'(c)  | Show that change in threshold voltage \( \Delta V_{th} \) due to short channel effect in a MOSFET can be expressed as:  

\[ \text{(Based on CO "2")} \] | [5] |

contd...
\[ \Delta V_{th} \approx -2\beta_1 \frac{e_1}{e_{ox}} t_{ox} (\phi_0 + V_{sd}) \], where terms used in the expression have their usual meaning.

2(a) Starting with the drain-to-source current expression \( I_{ds} = \frac{W}{L} \left[ \int (\psi_{SL}) - \int \psi_{so} \right] \) for MOSFET, derive an expression for non-saturation current relating to the voltages \( V_{GS} \) and \( V_{DS} \) in the presence of velocity saturation effect. \( \{\text{Based on CO "2"}\} \)

2(b) For a 3-terminal MOS device with \( N_A = 10^{17} \text{ cm}^{-3} \), a SiO2 insulator with a thickness \( T_{ox} = 100 \text{ 0A} \), and \( V_{FB} = -1 \text{V} \), determine \( V_{1B} \) and \( V_{MB} \) for \( V_{CB} = 0 \text{V} \). \( \{\text{Based on CO "2"}\} \)

(OR)

2'(a) Define an effective depletion charge \( \hat{Q}_{d} \) in the case of channel of MOSFET are both short and narrow. Derive the resulting expression for effective threshold voltage \( \hat{V}_{T} \). \( \{\text{Based on CO "2"}\} \)

2'(b) What do you mean by flat band voltage? Calculate the flat-band voltage for a p-type substrate with \( N_A = 9 \times 10^{16} \text{ cm}^{-3} \), a SiO2 insulator with a thickness \( T_{ox} = 100 \text{ 0A} \), and n-type polysilicon gate with \( N_D = 10^{20} \text{ cm}^{-3} \). The interface charge per unit area \( Q_0 \) is \( 10^{-8} \text{ C/cm}^2 \). Assume fermi-potential of the substrate equal to 0.41V and n-type polysilicon gate = 0.56V. \( \{\text{Based on CO "2"}\} \)

3(a) Write short notes on the following: \( \{\text{Based on CO "3" & "4"}\} \)
   i) Non-Quasi Static Model
   ii) Gate Parasitics Model at RF

3(b) In the Fig. 1, for each of the following cases, does the high frequency (HF) MOS C-V or the MOSFET C-V characteristic apply? (i) MOSFET operating at 5.0 KHz. (ii) MOS operating at 1.0 GHz. Support your answer with brief explanation.

\[ \text{Fig. 1} \{\text{Based on CO "3" & "4"}\} \]

4(a) Differentiate between simple and unified charge control model (UCCM). Explain how the UCCM simplifies in specific region of operation. \( \{\text{Based on CO "2"}\} \)

4(b) i) State various sources of noises in MOSFET at high frequency. How their effects are accounted in BSIM3 model? Explain. \( \{\text{Based on CO "3"}\} \)
   ii) Differentiate between quasi-static and non-quasi static models. Briefly explain their effect on MOSFET model performance at RF. \( \{\text{Based on CO "3" & "4"}\} \)
Max. Marks: 60

Answer all questions

All symbols & notations have their usual meaning in the context of this course

Q.1. (a) Describe the Custom and Semicustom chip design approaches. Also list their merits and demerits. (10) CO-1

(b) What do you understand by the following design strategies: Hierarchy, Regularity, Modularity and Locality? (5) CO-2

(c) A primitive gate array is shown in Fig. 1. Show the wiring of programmed cell implementing a 4-input NOR gate. (5) CO-2

Q.2. (a) Draw a block diagram depicting basic architecture of BIST. Briefly describe the function of each block. (10) CO-3

OR

(a') What do you understand by Fault Equivalence in CMOS Testing? Describe the Fault Equivalence Rule for basic logic gates and calculate the Collapse Ratio for the circuit shown in Fig. 2. (10) CO-3

---

Figure-1

Figure-2
(b) Briefly describe Ad Hoc test and Scan test approaches for CMOS circuits. (10) CO-3

Q.3. (a) With the help of 6T SRAM cell, describe how the Hold SNM and Read SNM are measured. (10) CO-4

OR

(a') With the help of circuit diagram describe the design principle of Transmission Gate based full adder. (10) CO-4

(b) What do you understand by $I_{ON}/I_{OFF}$ ratio of an SRAM cell? Why is this ratio important for SRAM array design? (5) CO-4

(c) Describe the design and operation of 4 x 4 Carry Save Multiplier. (5) CO-4
Max. Marks: 60

Note:
I. Attempt ALL Questions
II. Make appropriate assumptions if required
III. Symbols and abbreviations have their usual meanings.

1 a Define the terms YIELD and TROUGHPUT. If yield for every process step is 99%, what is the overall yield after 600 processing steps? By considering appropriate example, explain, how yield affects the profit and loss of the fabrication process. (7)

1 b What are the physical mechanisms used to remove the contamination? What are the common design practices for clean rooms? (8)

2 a Differentiate between the CZ and FZ processes of Si crystal growth. Explain FZ process of Si crystal growth. (5)

2 b What are the disadvantages of wet cleaning? Describe the RCA cleaning method. (5)

OR

2 b' How the Electronic Grade Silicon is obtained from Silica? (5)

2 c Compare the different types of CVDs processes (APCVD, LPCVD and PECVD). With the help of sketch, explain the operation of a typical APCVD system. (5)

3 a Assume that the gas \( AB \) is introduced into a reactor and the only chemical reaction that occurs in the chamber is

\[
AB \quad (g) \quad \leftrightarrow \quad A \quad (g) \quad + \quad B \quad (g)
\]

If the process is run at 1 atm (760 torr) and temperature of 1000 K the process reaches chemical equilibrium, calculate the partial pressure of each species. The equilibrium constant for the reaction is given by

\[
K_p(T) = 1.8 \times 10^9 \text{ (torr)} e^{-2.0eV/kT}.
\]

\( \text{contd...} \)
3 b What is the need of Epitaxial layer in ICs fabrication? How Epitaxial Silicon layer is deposited?

3 c What are the heating techniques used in Evaporation System. How alloys film are deposited using physical vapor deposition?

OR

3 e Why low temperature processes are preferred in IC fabrication? With the help of sketch, explain the operation of a typical PECVD system.

4 a How the isolation is achieved in Integrated Circuits? Describe the different type of isolation scheme used in Integrated Circuits.

4 b Differentiate between wet and dry oxidation. An oxidized Si wafer has an initial field oxide thickness of \( x_i \). Patterned windows of the field oxide are completely cleared by etching. Dry Oxygen at 900°C is then used to grow a thin gate oxide in these cleared regions. As shown in figure below.

\[
\begin{align*}
\text{SiO}_2 & \quad \text{Si} \\
\text{Opening} & \quad \text{SiO}_2 & \quad \text{SiO}_2 \\
\text{Si-substrate} & \Rightarrow \quad \text{Si-substrate} & \Rightarrow \quad \text{Si-substrate}
\end{align*}
\]

Find the oxidation time to grow 0.1 μm of gate oxide? [Given: \( B = 5600 \) Å/min, \( B/A = 2 \) Å/min]. After the 0.1 μm gate oxidation step, total thickness in the field oxide region is found to be 0.5 μm. What is the original field oxide thickness \( x_i \)?

OR

4 f Draw the circuit diagram of simple 2 input TTL NAND gate. With the help of sketches, explain the all fabrication steps of simple 2 input TTL NAND gate.
Answer all the questions.
Any missing information can suitably be assumed.
Notations used have their usual meaning.

1(a) CO2 A memoryless ternary source with output alphabet \( a, b, \) and \( c \) and corresponding probabilities 0.2, 0.3 and 0.5 produces sequences of length 10000.

(i) What is the approximate number of typical sequences in the source output?

(ii) What is the probability of a typical sequence?

(iii) What is the number of bits required to represent all output sequences?

(b) CO2 Let the random variable (RV) \( X \) has five possible outcomes \{a, b, c, d, e\}. Consider two distributions for this random variable, \( p \) and \( q \).

<table>
<thead>
<tr>
<th>Symbol</th>
<th>( p(x) )</th>
<th>( q(x) )</th>
<th>( C_1(x) )</th>
<th>( C_2(x) )</th>
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</thead>
<tbody>
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<td>1/2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( b )</td>
<td>1/4</td>
<td>1/8</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>( c )</td>
<td>1/8</td>
<td>1/8</td>
<td>110</td>
<td>101</td>
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<tr>
<td>( d )</td>
<td>1/16</td>
<td>1/8</td>
<td>1110</td>
<td>110</td>
</tr>
<tr>
<td>( e )</td>
<td>1/16</td>
<td>1/8</td>
<td>11111</td>
<td>111</td>
</tr>
</tbody>
</table>

(i) Calculate \( H(p) \), \( H(q) \), \( D(p\|q) \) and \( D(q\|p) \).

(ii) The last two columns of the table represent codes for the RV. Verify that \( C_1 \) is optimal with \( p \), whereas \( C_2 \) is optimal with \( q \).

(iii) Now assume that \( C_2 \) is used with distribution \( p \). What is the average length of the codewords? By how much does it exceed the entropy \( H(p) \)?

(iv) What is the loss if use \( C_1 \) with distribution \( q \)?

OR

(b') CO2 Two players, A and B, play the game of matching pennies: at each time \( n \), each player has a penny and must secretly turn the penny to heads or tails. The players then reveal their choices simultaneously. If the pennies match (both are head or both are tail), Player A wins the penny. If the pennies do not match (one heads and one tails), Player B wins the penny. Suppose the players have between them a total of 5 pennies. If at any time one player has all of the pennies, to keep the game...
going, he gives one back to the other player and the game will continue. Show that this game can be formulated as a Markov chain.

2(a) **CO1** Gilbert-Elliot channel model is shown in Fig - 1. Suppose that \( \epsilon_1 = 10^{-6} \) and \( \epsilon_2 = 0.1 \).
   (i) Find the average length of an error burst (same as the average time of staying in the bad state).
   (ii) Find the average length of an error free sequence of bits.

\[
1 - \epsilon_1 \quad \epsilon_1 \quad \epsilon_2 \quad 1 - \epsilon_2
\]

\( \epsilon_1 = 10^{-6} \)
\( \epsilon_2 = 10^{-1} \)

Fig - 1

(b) **CO1** What is the difference between a frequency selective channel and a flat fading channel? Derive an expression for the maximum channel capacity of a frequency selective channel.

OR

(b') **CO1** Find the channel capacity of the discrete memory-less channel whose model is shown in Fig - 2, and show that it depends on the value of \( a \).

\[
\begin{align*}
Z & \quad \mid \quad X \quad + \quad \mid \quad Y \\
& \downarrow \\
& X 
\end{align*}
\]

Fig - 2
Where \( P\{Z=0\} = P\{Z=a\} = 0.5 \). The alphabet of \( x \) is \( \mathcal{A} = \{0, 1\} \). Assume that \( Z \) is independent of \( X \).

3(a) **CO3** The following two equations define a (7, 5) single error correcting block code with symbols from \( GF(7) \)
\[
\begin{align*}
c_0 + c_1 + c_2 + c_3 + c_4 + c_5 + c_6 &= 0 \\
c_1 + 2c_2 + 3c_3 + 4c_4 + 5c_5 + 6c_6 &= 0
\end{align*}
\]
Let \( c_5 \) and \( c_6 \) be check digits. Find encoding equations for \( c_5 \) and \( c_6 \) in terms of \( c_0, c_1, c_2, c_3 \) and \( c_4 \).

(b) **CO4** Draw the Tanner graph of a linear block code having the following check matrix
\[
H = \begin{bmatrix}
1 & 1 & 0 & 1 & 1 & 0 \\
1 & 0 & 1 & 0 & 1 & 1 \\
0 & 1 & 0 & 0 & 1 & 1
\end{bmatrix}
\]
Using bit flipping algorithm decode the sene:word: 0 0 1 1 0 1.

(c) **CO3** Let \( C_1 \) be a repetition (3, 1) code and \( C_2 \) be a simplex (7, 3) code. Using \( C_1 \) and \( C_2 \)
how can you design a (10, 4) code? What will be $d_{min}$ of this new code?

OR

(c') CO3 Construct a $RM(1,3)$ code. Decode the received vector 10001100 using majority logic decoding.

4(a) CO4 What are the rateless codes? Discuss one method of constructing a rateless code.
(b) CO4 Outline an encoding method of turbo codes.
(e) CO3 For the encoder shown in Fig – 3

![Diagram](image)

Fig – 3

employed with an 8-PSK constellation partitioned according to Ungerboeck rules.

(i) Draw the trellis for the TCM encoder, labelling the state transitions with the subsets from the constellation.
(ii) Determine the $d_{free}$ between paths which deviate from all-zero path, both for non-parallel (if you can) and for parallel paths. Determine minimum free distance for the code.
(iii) Determine the asymptotic coding gain of the system compared with 4-PSK transmission.

(e') CO3 Construct the RS code of length 6 with minimum distance 5 over GF(7).

(i) Find primitive element for this field.
(ii) Calculate generator polynomial of the code.
(iii) Calculate the parity check polynomial of the code.
INSTRUCTIONS TO THE EXAMINEES
- Answer ALL questions.
- Assume suitable data where necessary
- Notations used have their usual meaning.

1 a Explain the production of semi vowel sound in English language with reference to changes in the position articulator. [CO1]

1 b A single recording of speech signal for isolated words is carried out using the format, “SILENCE-WORD1-SILENCE-WORD2-SILENCE-...”. Propose an algorithm that can be used to extract each word from the recording. [CO2, CO4]

2 a Explain different subjective and objective methods used for assessment of speech quality achieved by compression algorithm? [CO2]

2 b Explain the design of codebook for vector quantization of speech signal using the LBG algorithm. [CO4]

3 a Compare the performance of feed-back and feed-forward adaptation carried out during the quantization process of speech signal. [CO1]

3 b Draw a general Analysis-by-Synthesis scheme used in speech compression. Explain the how perceptually based minimization procedure is used to minimize the error signal. [CO1, CO2, CO3, CO4]
3 b' Discuss any one of the method used for speech synthesis. Explain the problem encountered at boundaries in concatenated speech synthesis and propose a possible solution. [CO1, CO2, CO3, CO4]

4 Explain how Hidden Markov Model is used to develop acoustic model of a phoneme in speech recognition application. Draw the trellis diagram of 3 state HMM having 5 observations in a sequence. Evaluate the order of computation required to calculate the probability of an observation sequence given the model and show how it can be efficiently calculated using Forward/Backward algorithm. [CO1, CO2, CO4, CO5]

OR

4' a What are the various pre-processing steps used at the front end of an automatic speech recognition system? [CO5]

4' b Explain how coding delay is reduced in the CELP. Draw the block diagram of ITU G.728 coder/decoder and explain its working. [CO1, CO2, CO4]
Answer all the questions.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

Q.No. | Question | M.M.
--- | --- | ---
1(a) | Show that the output signal from a matched filter whose input is a rectangular pulse (to which it is matched) is triangular in form with a duration twice that of the input. (CO1) | [08]

OR
1(a') | A binary code is given as follows 1, -1, 1, -1, 1, 1, -1, -1, 1, -1, 1, 1 Find the autocorrelation function (ACF) of the code, obtained by passing it through matched filter. What is the ratio between the central peak of the ACF and its largest time side lobe? (CO1) | [08]
1(b) | What are radar beacons? What are its applications? (CO1) | [07]

2(a) | The antenna of a ships radar is mounted 20m above the sea surface. What is its approximate distance to horizon for (a) a navigation buoy on the sea surface and (b) a light house tower rising to a height of 50m above sea level? (CO2) | [08]

OR
2(a') | A synthetic aperture radar system operating at 450MHz is desired for a space borne platform. The system is required to achieve a spatial resolution of 12m*12m or better on the ground, and a minimum swath width of 60km when operating at an 800km altitude with incidence angle 35 degrees. The platform moves at velocity 7000 m/s. Design a synthetic aperture radar system by providing values for the... | [08]
following parameters.
- Pulse repetition frequency
- Antenna dimensions in meters
- Radar bandwidth (CO2)

2(b) Discuss the effect of meteorological echoes on radar system (CO2) [07]

3(a) What is the Very High Frequency Omni Range (VOR) system of navigation? What are its merits and demerits? (CO3) [08]

3(b) Compare in details LORAN A and LORAN C navigation systems. (CO3) [07]

4(a) Discuss different types of Global Navigation Satellite System (GNSS) (CO4) [08]

OR

4(a') On what principle the Inertial navigation system works? Explain in details. (CO4). [08]

4(b) Explain Ground control approach (GCA) system of aircraft landing system. (CO4) [07]
1(a) A computer (with logical address A and physical address 40) sends a message to another computer (with logical address D and physical address 80) via LAN1, router R1, and LAN2. (i) Show the contents of the packets and the frames at the network layer and at the data link layer for each hop interface.

(ii) In above figure, assume that the communication is between a process running at Computer A with port address i and a process running at Computer D with port address j. Show the contents of the packets and the frames at the network layer, data link layer, and the transport layer for each hop interface.

OR

1(a') A long distance point-to-point data link uses an idle (stop-and-wait) ARQ strategy with half-duplex transmission and has the following characteristics: Data transmission rate = 5.4 kbps, Frame size = 896 bits, Propagation delay = 10 ms. If processing delays and acknowledgement transmission time can be neglected, determine the link utilization: (i) in the absence of errors and (ii) in the presence of bit error rate of $10^{-3}$.

1(b) What is sliding window protocol? Where is it used?
2(a) Consider building a CSMA/CD network running at 1 Gbps over a 1 km cable with no repeaters. The signal speed in the cable is 200,000 km/sec. What is the minimum frame size? [5] (CO2)

2(b) What are the advantages offered by Ethernet switches over bridges over repeater hubs? [5] (CO2)

OR

2(b') Explain the difference between the following two types of Ethernet switches: Store-and-forward switch and Cut-through switch. [5] (CO2)

2(c) Explain the 8B6T encoding used in 100BaseT4 and comment on its usefulness. [5] (CO2)

3(a) What is the difference between hidden station problem and exposed station problem encountered in Wireless networks? [5] (CO3)

3(b) What are the different physical layer techniques used in various IEEE802.11 standards? Which ones of these are more commonly used nowadays? [5] (CO3)

3(c) With regard to Wireless LANs, differentiate between PCF and DCF? Which one of these two offers a better Quality of Service, and why? [5] (CO3)

4(a) (i) Distinguish between Deterministic routing and Stochastic routing; (ii) Distinguish between single-path routing and multiple-path routing. [5] (CO4)

OR

4(a') What is Dijkstra’s Shortest Path algorithm? [5] (CO4)

4(b) For hierarchical routing with 4800 routers, what region and cluster sizes should be chosen to minimize the size of the routing table for a 3-level hierarchy? [5] (CO4)

4(e) Give a brief account of Open loop congestion control techniques used at the network layer. [5] (CO4)